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(54) A COOLING SYSTEM

(71) We, TELEFONAKTIEBOLAGET L M ERICSSON, a company organised under the laws of Sweden, of S-126 25 Stockholm, Sweden, do hereby declare the invention, for

which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a cooling system for cooling equipment which prodces heat, for example electronic equipment in aeroplanes.

According to this invention there is provided a cooling system for dissipating to the surroundings heat generated in an equipment, the system comprising a heat pipe, an evaporation part of which is thermally connected to the equipment and a condensation part of which is thermally connected to a porous heat conducting body which faces the surroundings, the said body being provided with means for the supply to it of a liquid evaporable at pressures and temperatures occurring in use of the system.

The porous body could comprise a sheet of sintered copper.

The porous body could be fastened on a condensation surface included in the condensation part of the heat pipe, a free surface of the body being exposed to the surroundings.

The porous body could face the surroundings in an opening in a wall of a craft, such as an opening in the fuselage of an aeroplane.

The evaporable liquid could be water.

Alternatively, the porous body could be connected to an air inlet of a combustion engine (such as a jet engine) of a craft (such as an aeroplane) so that substantially all vapour which is emitted by the body is brought via the air inlet to a combustion chamber of the engine. In this case, the evaporable liquid should be inflammable and have a high combustion heat.

The invention will now be described by way of example with reference to the single figure of the accompanying drawing, which schematically shows a cooling system for equipment in an aeroplane.

In a part 11 of the fuselage of an aeroplane, there is an aperture 12 in which there is a sheet 13 of a porous material, for example sintered copper. The sheet 13 has a number of mutually connected channels 14 to which a liquid can be supplied through a pipe 15. The sheet 13 is fastened on a plate 16 of a material, for example copper, having a good thermal conductivity. The plate 16 with the porous sheet 13 is fastened to the part 11 of the fuselage for example by rivets 17. Furthermore, the plate 16 is attached to an upper part (a condensation part) 22 of a heat pipe 18, a lower patr 19 of which is in close contact with equipment 20 which generates heat, for example transmitter equipment or a computer. In order to damp vibrations, the heat pipe is provided with suspension bellows 21.

Heat pipes, the operation of which is based on heat transmission between a heat generator and a cooling surface by means of evaparation and condensation of a cooling medium, are well known within the art and are described for example in "Electronics", Vol. 47, No. 25 1974, pp. 114—117. A heat pipe has as a characteristic feature that it can transmit large heat quantities over short distances with very little variation of temperature.

The system works in the following way, and as an example it can be assumed that the equipment 20 works at a temperature of about 50°C. If the heat transmission between the equipment 20 and the evaporation part 19 of the heat pipe is good, the heat pipe works at about the same temperature and, provided that as much heat is carried off from the condensation part of the heat pipe as is generated in the equipment 20, the plate 16 as well as the porous sheet 13 will have about the same temperature.

Liquid, for instance water, is supplied through the pipe 15 to the channels 14 in the sheet 13 and gets into contact with the outside air via capillaries of the sheet and will vaporized. The evaporation speed for a liquid, and consequently also the amount of heat being carried off per time unit, is mainly determined by the temperature of the liquid surface relative to the boiling point at the prevailing pressure, and the relative

contents of the vapour phase of this liquid in the surrounding air. As the air which is close to the surface of the aeroplane is heavily heated by friction, the relative humidity of the air will be low which facilitates the vaporization.

If the the vaporizing liquid is water having an evaporation heat 2250 kWs/kilogram, it is necessary to add 1.6 kilogram of water per hour to dissipate 1 kW power loss. The supply of cooling liquid is preferably controlled by placing a temperature measuring device in the sheet 13, which device controls the liquid supply by means of control circuits so that a constant temperature is maintained.

It is not necessary to utilize water as the vaporizing liquid. It is possible to utilize an inflammable liquid, for example methyl alcohol, light petrol or even jet fuel. In this case more liquid is consumed per cooled kWh, as these substances have a considerably lower evaporation heat. By placing the sheet 13 in connection with an air inlet of a jet engine it is possible, however, to let the evaporated liquid be consumed in the jet engine, resulting in that the evaporation liquid does not result in any extra weight charge but the engine will be benefited by the cooled heat energy.

By utilizing evaporation cooling of this kind, it is possible to provide all needs for cooling in an aeroplane and consequently also to avoid using compressor cooling systems. If the evaporation liquid consists of light petrol, it is possible to keep a temperature of 15—20°C at the plate 14. The cooling air which can be obtained via heat exchangers from the evaporation part of the heat pipe 18 can then have a temperature of 20—30°C which is sufficient for most purposes.

WHAT WE CLAIM IS:—

1. A cooling system for dissipating to the surroundings heat generated in an equipment, the system comprising a heat pipe, an evaporation part of which is thermally connected to the equipment and a condensation part of which is thermally connected to a porous heat conducting body which faces the surroundings, the said body being provided with means for the supply to it of a liquid evaporable at pressure and temperatures occurring in use of the system.

2. A cooling system according to claim 1, wherein the porous body comprises a sheet of sintered copper.

3. A cooling system according to claim 1 or 2, wherein the body is fastened on a condensation surface included in the condensation part of the heat pipe, a free surface of the body being exposed to the surroundings.

4. A cooling system according to any preceding claim, wherein the body faces the surroundings in an opening in a wall of a craft.

5. A cooling system according to any preceding claim, wherein the porous body has channels for the supply to the body of such an evaporable liquid.

6. A cooling system according to any preceding claim including a supply of such an evaporable liquid.

7. A cooling system according to claim 6, wherein the evaporable liquid is water.

8. A cooling system according to claim 3 or any of claims 4 to 6 as dependent on claim 3, wherein the porous body is connected to an air inlet of a combustion engine of the craft so that substantially all vapour which is emitted by the body is brought via the air inlet to a combustion chamber of the engine.

9. A cooling system according to claims 8 and 6, wherein the liquid is inflammable and has a high combustion heat.

10. A cooling system according to any preceding claim, wherein the porous body is provided with a temperature measuring device arranged for controlling the supply of evaporable liquid to the body.

11. A cooling system, substantially as herein described with reference to the single figure of the accompanying drawing.

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1526160 COMPLETE SPECIFICATION
1 SHEET *This drawing is a reproduction of the Original on a reduced scale*